

CLAIMS

I claim:

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1. A method of making a spinel-structured metal oxide on a substrate by molecular beam epitaxy, said metal oxide comprising oxygen atoms, first metal atoms, and at least one other metal atoms, wherein said metal atoms substantially occupy thermodynamically stable lattice positions of said metal oxide, comprising the steps of:
 - 10 providing a substrate in a growth chamber;
 - reducing the pressure in the growth chamber to a pressure suitable for epitaxial growth by molecular beam epitaxy;
 - heating said substrate to a suitable growth temperature;
 - supplying activated oxygen, a first metal atom flux, and at least one other metal
 - 15 atom flux to the surface of said substrate, wherein said metal atom fluxes are individually controlled at said substrate so as to grow said spinel-structured metal oxide having said metal atoms substantially occupying thermodynamically stable lattice positions of said metal oxide during the growth of said metal oxide;
 - terminating the supply of said activated oxygen, said first metal atom flux, and
 - 20 said at least one other metal atom flux at the surface of said substrate once the desired thickness of said metal oxide is formed on said substrate; and
 - cooling said metal oxide to room temperature.
2. The method as recited in claim 1, further comprising the step of growing a
- 25 spinel buffer layer on said substrate by molecular beam epitaxy prior to growing said metal oxide on said substrate.
3. The method as recited in claim 1, wherein said metal atom fluxes are individually controlled at said substrate using an atomic absorption spectroscopy
- 30 detection system.

4. A method of making a spinel-structured binary ferrite on a substrate by molecular beam epitaxy, said binary ferrite comprising oxygen atoms, iron atoms, and second metal atoms, wherein said metal atoms substantially occupy thermodynamically stable lattice positions of said binary ferrite, comprising the steps of:

5 providing a substrate in a growth chamber;

reducing the pressure in the growth chamber to a pressure suitable for epitaxial growth by molecular beam epitaxy;

supplying activated oxygen to the surface of said substrate at an oxygen pressure

10 between 1×10^{-5} torr and 1×10^{-3} torr;

heating said substrate to a growth temperature between 150°C and 350°C ;

lowering said oxygen pressure to approximately 1×10^{-5} torr;

supplying an iron atom flux and a second metal atom flux to the surface of said substrate, wherein said metal atom fluxes are individually controlled at said substrate so

15 as to grow said spinel-structured binary ferrite having said metal atoms substantially occupying thermodynamically stable lattice positions of said binary ferrite during the growth of said binary ferrite;

terminating the supply of said activated oxygen, said iron atom flux, and said second metal atom flux at the surface of said substrate once the desired thickness of said

20 binary ferrite is formed;

reducing said oxygen pressure to less than 1×10^{-7} torr; and

cooling said binary ferrite to room temperature.

5. The method as recited in claim 4, wherein said spinel structure is an

25 inverse spinel structure.

6. The method as recited in claim 4, wherein said second metal atom flux is a metal flux comprising Co.

7. The method as recited in claim 4, wherein said second metal atom flux is a metal flux consisting essentially of Co.
8. The method as recited in claim 4, wherein said substrate is selected from the group consisting of SrO, MgO, BaO, MgAl₂O₄, and SrTiO₃.
9. The method as recited in claim 4, wherein said growth temperature is between 200° C and 300° C.
10. The method as recited in claim 4, wherein said activated oxygen is provided by an oxygen plasma source.
11. A method of making a spinel-structured metal oxide on a substrate by oxygen plasma assisted molecular beam epitaxy, comprising the step of supplying activated oxygen from an oxygen plasma source, a first metal atom flux, and at least one other metal atom flux to the surface of said substrate, wherein said metal atom fluxes are individually controlled at said substrate so as to grow said spinel-structured metal oxide on said substrate and said metal oxide is substantially in a thermodynamically stable state during the growth of said metal oxide.
12. The method as recited in claim 11, wherein said metal atom fluxes are individually controlled by an atomic absorption spectroscopy detection system.
13. The method as recited in claim 11, wherein said spinel-structured metal oxide is a binary ferrite having an inverse spinel structure.
14. The method as recited in claim 13, wherein said binary ferrite is Co ferrite.
15. The method as recited in claim 13, wherein said substrate is MgO.

16. A structure comprising a spinel-structured metal oxide on a substrate made in accordance to claim 11.

17. A method of making an inverse spinel-structured Co ferrite on a substrate
5 by oxygen plasma assisted molecular beam epitaxy, wherein at least 90% of the cobalt atoms occupy octahedral lattice positions of the Co ferrite during growth of the Co ferrite, comprising the step of supplying activated oxygen from an oxygen plasma source, an iron atom flux, and a cobalt atom flux to the surface of said substrate, wherein said iron and cobalt atom fluxes are individually controlled at said substrate by an atomic
10 absorption spectroscopy detection system.

18. The method as recited in claim 17, wherein said substrate is MgO.

19. A structure comprising an inverse spinel-structured Co ferrite on a
15 substrate made in accordance to claim 17.

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